Quantum, Chiral, and Magnetic Light-Matter Interactions

Jennifer Dionne, Jonathan Scholl, Aitzol Garcia, Sassan Sheikholeslami,
and Ai Leen Koh

Electromagnetic radiation can interact strongly with metallic and semiconducting nanostructures, exciting localized Mie or plasmonic resonances. In multiparticle systems, the modes of individual particles hybridize to form new, collective modes that can exhibit enhanced or entirely distinct properties from the individual particle resonances. In this talk, we explore the optical-frequency quantum, magnetic, and chiral modes that can be achieved with multiparticle assemblies. Aberration-corrected transmission electron microscopy in combination with electron-energy loss spectroscopy allows us to dynamically image, manipulate, and collect spectra of plasmonic dimers as the interparticle separation enters the sub-nanometer regime. Using the properties of coupled metallic nanoparticles, we demonstrate the colloidal synthesis of an isotropic metafluid that exhibits a strong magnetic response at visible frequencies. Finally, we show that simultaneous optical-frequency electric and magnetic dipoles can enable enhanced circular dichroism spectroscopy, even with non-chiral nanostructures. Our results may provide new avenues for large-scale, *in-situ* assembly and analysis of molecular and nanoscale systems.